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L. O. HOWARD, Entomologist and Chief of Bureau.

PAPERS ON INSECTS AFFECTING VEGETABLES.

THE HAWAIIAN BEET WEBWORM.

BY

H. O. MARSH,

Agent,
Engaged in Sugar-Beet and Truck-Crop
Insect Investigations.

[With Appendix by H. G. Dyar and F. H. Chittenden.]

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PAPERS ON INSECTS AFFECTING VEGETABLES.

THE HAWAIIAN BEET WEBWORM.

(*Hymenia fascialis* Cram.)

By H. O. Marsh,
Agent, engaged in Sugar-Beet and Truck-Crop Insect Investigations.

INTRODUCTORY.

During the latter half of 1910 the author was engaged in a study of insects affecting truck crops in the Hawaiian Islands. The enemies of beets and of the so-called spinach (*Amaranthus* sp.) were among the insects which were studied. The species injurious to these two crops had previously received very little study from an economic standpoint, and the necessity of such study was further enhanced by the fact that a land company was experimenting with sugar beets on the island of Lanai[1] with the intention of growing this crop on a large scale, if it should offer promise of becoming profitable.

In the vicinity of Honolulu, on the island of Oahu, vegetables are grown in commercial gardens, managed by Chinese or Japanese. In a general sense, these growers may be considered "good farmers" although they have little regard for the necessity of clean culture and seldom make any intelligent effort to combat insect pests or plant diseases. In the rare cases where an effort is made to cope with such troubles, the methods employed are extremely crude. Practically all cultivation is done by hand, except that occasionally the water buffalo is used for plowing the land before the crops are planted. From the Oriental point of view this plowing is considered sufficient if the surface of the ground is scratched to the depth of a few inches. The fertilizing material used is in liquid form. It is prepared by soaking stable manure or other refuse material in water and is applied directly about the plants.

Table beets and "spinach" are produced exclusively for the local market. These vegetables are grown in beds, in a peculiar manner, which Mr. E. M. Ehrhorn has aptly designated "the graveyard style." The beds, which are very often about 10 yards long by 1 yard wide, are mounded up about 6 to 8 inches above the surrounding surface, the top is leveled, and the seeds are planted on these elevated plats, which have an appearance very suggestive of graves.

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[1] The sixth largest island of the group.

Although the climate is rather humid the normal rainfall, at Honolulu, is so light that irrigation is necessary to produce a crop. Practically all the gardens have an abundant supply of artesian water, but, owing to the manner in which the beds are elevated, it is impossible to run the water between the rows of plants, and as a result they have to be watered by hand. This is accomplished by dipping up the water in large watering cans and sprinkling it over the beds. It would seem that this slow and laborious method of irrigation could be eliminated if the beds were prepared in a more up-to-date manner.

The so-called spinach is not the plant which is recognized by that name in mainland markets, but is a species of Amaranthus. The leaves and stems of the young and tender plants, when properly cooked, make fairly palatable "greens."

FOOD PLANTS AND INJURY.

The most conspicuous enemy of this class of vegetables is the Hawaiian beet webworm (*Hymenia fascialis* Cram.). In the Hawaiian Islands the larvæ of this species include among their food plants table beets, sugar beets, stock beets (mangel-wurzels), several species of Amaranthus, Euxolus, purslane (*Portulaca oleracea*), cucumbers, and chenopodiaceous weeds. Among the wild food plants, Amaranthus is the favorite. These weeds grow in abundance along fences and in neglected spots, and it frequently happens that the plants are so completely stripped of foliage that large patches of them die. Cultivated Amaranthus is likewise severely damaged. Beets are a close second in attractiveness, and it is not unusual to see beds of this vegetable with nothing remaining of the foliage but the petioles. When infestation is very severe the plants are occasionally killed outright, and even when the larvæ are less abundant the infested beets are stunted in growth and injured in quality. Sugar beets are attacked as readily as the table variety. During the latter part of August, 1910, the author received some sugar beets from the experimental plats on Lanai, from which practically all the foliage had been stripped, and it was reported that all the beets in the plats were in a similar condition. This webworm is the most serious insect pest which menaces the production of sugar beets in Hawaii, and unless it is controlled it is unlikely that this crop can be profitably grown. Cucumbers are apparently only rarely attacked and the occasional larvæ which were found infesting this cucurbit were doubtless feeding on it because more attractive food was not available. Portulaca is commonly attacked but apparently is not so favored a food as Amaranthus or beets.

LIFE HISTORY AND HABITS.

All stages of this pest can be found throughout the year. The moths (fig. 1) are usually to be found in abundance among the foliage of Amaranthus, beets, or other low-growing plants. During the day they remain concealed, usually on the underside of the leaves, but when disturbed they fly readily. They are but rarely attracted by lights. The scale-like iridescent eggs (fig. 2, *a*) are almost invariably deposited on the underside of the leaves. They are placed singly, in pairs, or in rows of five or more. On beet leaves, the favorite place for depositing eggs is along the midrib and larger veins. As many as 40 eggs, which had been deposited in the field under normal conditions, were counted on a single beet leaf. The eggs have been observed to hatch in 4 days. The young larvæ feed on the lower surface of the leaves. On beets, and probably on other plants, the larvæ, except when nearly mature, consume only this surface. This habit of remaining on the underside of the leaves, without eating through the upper epidermis, adds to the difficulty of successfully treating this pest with insecticides. (See larva and details, fig. 2, *b–e*.)

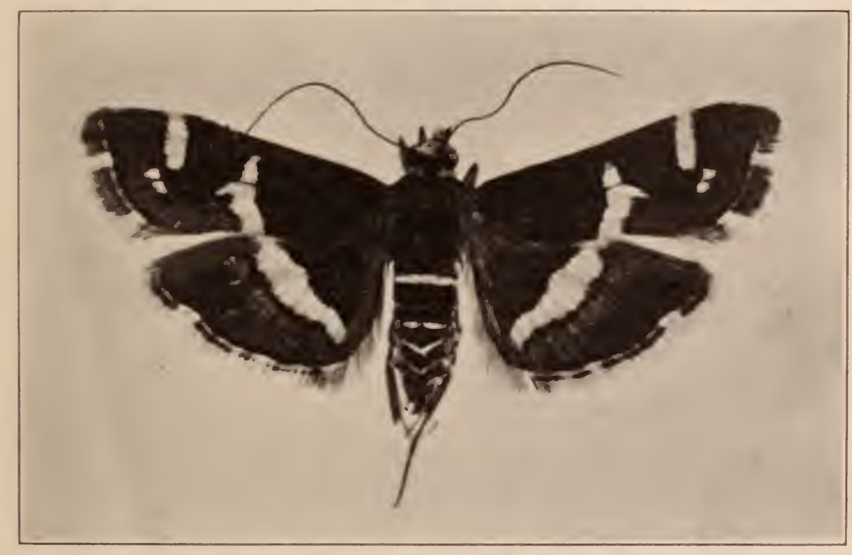

FIG. 1.—The Hawaiian beet webworn (*Hymenia fascialis*): Female moth. Enlarged. (Original.)

In some cases the larvæ spin light webs, under which they rest. This web-forming habit is not very pronounced, and it is not unusual to find hundreds of larvæ without any webs whatever.

Under normal conditions the larvæ reach maturity in from 9 to 13 days. They then leave the plants, burrow slightly beneath the surface, and form firm, compact, oblong cocoons of webbed-together grains of earth. From the time of hatching until fully mature, the larvæ are pale green, but while engaged in constructing their cocoons (fig. 2, *h*), they change to a reddish pink. They usually pupate about 2 days after entering the soil, and the adults issue from 7 to 13 days later, thus completing a generation in from 22 to 31 days. (See pupa and details, fig. 2, *f*, *g*.)

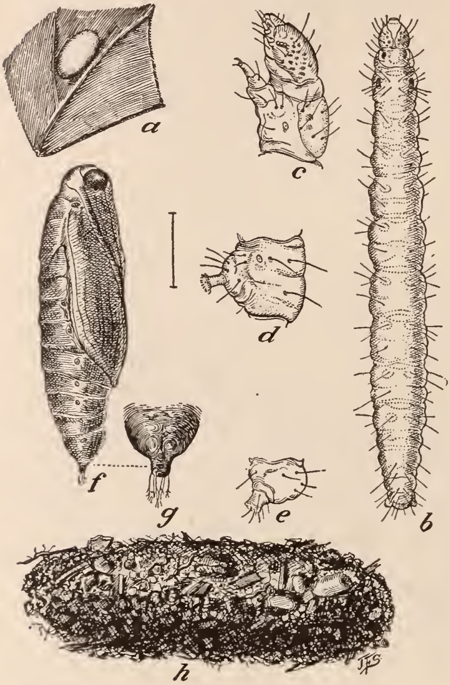

Fig. 2.—Hawaiian beet webworm: *a*, Egg on leaf; *b*, larva, dorsal view; *c*, larva, head and first thoracic segment; *d*, abdominal segment, lateral view; *e*, anal segment; *f*, pupa, lateral view; *g*, cremaster; *h*, cocoon. All enlarged. (Original.)

The climate of Hawaii is so equable that this pest is enabled to breed continuously, and it is possible that ten or twelve generations might be produced annually. Owing to the overlapping of broods and to the fact that eggs, larvæ, pupæ, and adults are to be found at almost any time, it is practically impossible to work out the number of generations for a given year from field observations alone.[1]

Beginning in July, 1910, and continuing past the middle of January, 1911, the author reared this species through six generations in the insectary. The records of five of these generations are given below. The actual first (July-August) generation was reared from larvæ which were collected in the field, and as the egg stage was not obtained the record is incomplete and is not included in this paper. For the sake of convenience the August-September generation is mentioned as the first, although, in reality, it was the second. The five following generations are in direct line of descent.

FIRST GENERATION.

August 20.—At this date four moths were collected in the field and confined in a cage.

August 25	First eggs deposited.
August 29	The eggs hatched.
September 7	First larvæ reached maturity.
September 9	First larvæ pupated.
September 16	First adults issued.

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[1] It is not probable, however, that more than six generations can be produced successively, beginning with one pair of moths, since insects in general, in the writer's experience, always undergo a resting stage—sometimes two.—F. H. Chittenden.

From the above record the stages are as follows:

	Days.
Egg stage	4
Larval stage	11
Pupal stage	7
Total	22

SECOND GENERATION.

September 16	Adults issued.
September 18	First eggs deposited.
September 22	The eggs hatched.
October 3	First larvæ reached maturity.
October 5	First larvæ pupated.
October 15	First adults issued.

From the above record the stages are as follows:

	Days.
Egg stage	4
Larval stage	13
Pupal stage	10
Total	27

THIRD GENERATION.

October 15	Adults issued.
October 17	First eggs deposited.
October 21	The eggs hatched.
November 1	First larvæ reached maturity.
November 3	First larvæ pupated.
November 12	First adults issued.
November 13	More adults issued.

From the above record the stages are as follows:

	Days.
Egg stage	4
Larval stage	13
Pupal stage	9
Total	26

Curiously enough the first moths, 10 in number, which issued November 12, failed to deposit any eggs, so the first eggs deposited by moths which issued the following day (Nov. 13) were retained to commence the succeeding generation.

FOURTH GENERATION.

November 13	Adults issued.
November 16	First eggs deposited
November 20	The eggs hatched.
December 2	First larvæ reached maturity.
December 5	First larvæ pupated.
December 17	First adults issued.

From the above record the stages are as follows:

	Days.
Egg stage	4
Larval stage	15
Pupal stage	12
Total	31

FIFTH GENERATION.

December 17	Adults issued.
December 19	First eggs deposited.
December 23	The eggs hatched.
January 4	First larvæ reached maturity.
January 6	First larvæ pupated.
January 19	First adults issued.

From the above records the stages are as follows:

	Days.
Egg stage	4
Larval stage	14
Pupal stage	13
Total	31

These records were obtained in an open-air insectary at Honolulu. The moths were confined in open-wire cages, which contained an inch or more of moistened, sterilized soil. Beet or Amaranthus leaves, upon which the eggs were to be deposited, were placed in the cages and food was supplied the moths by putting in wads of absorbent cotton, which had been saturated in molasses and water. This food was evidently greatly relished. The moths were very "wild" and flew about very actively whenever the cages were approached. Copulation evidently took place at night, as during the several months that the species was kept under daily observation, in the insectary and field, no mating pairs were observed. Owing to the failure to obtain mating pairs and to the fact that it is difficult to distinguish the sexes when the moths are fluttering wildly about in the cages, no individual egg-laying records were obtained. In one case three newly emerged and unfertilized female moths were placed in a cage and supplied with molasses as food. They lived 10 days, and during this time deposited 300 eggs. Such a record is not conclusive, but it indicates that each female is capable of depositing at least 100 eggs. This is doubtless far short of the actual number of eggs that one female could deposit under normal conditions.

Temperatures at Honolulu during the time the species was reared.

Month.	Minimum temperature.	Maximum temperature.	Average mean temperature for entire month.
1910.	°*F.*	°*F.*	°*F*
July	69	84	76.5
August	66	85	76.8
September	69	85	77.0
October	65	84	75.3
November	66	84	74.6
December	62	80	71.2
1911.			
January	58	79	70.0

NATURAL ENEMIES.

At various dates larvæ were collected in the field and confined in cages in the insectary. In this way three species of hymenopterous parasites were obtained. These were *Limnerium hawaiiense* Cram., *Chelonus blackburni* Cram., and *Cremastus hymeniæ* Vier.

L. hawaiiense was obtained in greatest numbers during August and September, while *C. blackburni* apparently became more abundant during December. *C. hymeniæ* was reared only in small numbers and at all times appeared to be more rare than the other species. No predaceous enemies were actually observed feeding on the Hymenia larvæ or pupæ, but on several occasions a species of wasp (*Polistes hebræus* Fab.) was seen buzzing about infested plants. During the warmer months this wasp and allied species are efficient enemies of the common cabbage worm (*Pontia rapæ* L.), and it is not improbable that they also occasionally kill Hymenia larvæ. On the whole, the natural enemies apparently do not reduce the number of Hymenia larvæ sufficiently to be of much practical value.

EXPERIMENTS WITH INSECTICIDES.

During the fall of 1910, an opportunity was taken to make some experiments against the Hymenia larvæ with insecticides. The experiments were as follows:

Experiment No. 1.—Paris green, 4 pounds, and lime, 4 pounds, in 100 gallons of water. September 1, three beds of table beets, each 10 yards in length and 1 yard wide, were sprayed with about 2 gallons of this mixture. The application was made with a portable, compressed-air sprayer, which was fitted with a short extension-rod elbow and a Vermorel type nozzle. The mixture was applied chiefly to the upper surface of the leaves and it adhered very well. The weather at the time of the application was hot and clear and without a breeze.

The following day all the larvæ were alive, except those on occasional leaves which were poisoned on the underside. Thirty-three live larvæ were counted on the underside of one leaf. These beds were examined daily, and on September 7 it was concluded that the experiment was a failure, as the larvæ, except on the leaves which had been thoroughly sprayed on the underside, were unharmed. It was noted that on leaves which had been but partially sprayed on the underside the larvæ avoided the poisoned portion but continued to feed on the part which had been missed by the spray. The failure of this experiment was due to the habit the larvæ have of feeding on the underside of the leaves, without eating through the upper epidermis. The mixture used in this experiment burned the partly consumed leaves slightly but caused no extensive injury.

Experiment No. 2.—Paris green, 2 pounds, and whale-oil soap, 8 pounds, in 100 gallons of water. September 7, three beds of table beets, each 10 yards in length and 1 yard wide, were sprayed with about 3 gallons of this mixture. The same apparatus was used as in experiment No. 1. A particular effort was made to wet the under surface of the leaves thoroughly. The mixture adhered perfectly and an extremely even distribution of the poison was obtained. The weather was hot and clear.

The following day nearly all the larvæ were dead and the few individuals which remained alive appeared very sick. September 10, the beets were free of larvæ and the foliage showed no burning by the spray mixture. Two weeks later the sprayed plants were still free of larvæ, while beets in adjoining (check) beds were badly infested. This experiment plainly demonstrates that if the spray is applied properly, i. e., to the underside of the leaves, it can be depended on to control this pest.

In addition to the experiments with Paris green, a few preliminary and somewhat inconclusive tests were made with arsenate of lead, lead chromate, and lime-sulphur solution. For the sake of convenience these will be classed as experiments.

Experiment No. 3.—Arsenate of lead, 1½ ounces, and molasses, 1 quart, in 1½ gallons of water. This mixture was experimented with as a poisoned bait for the melon fly (*Dacus cucurbitæ* Coq.), and was not originally intended for use against the Hawaiian beet webworm. September 7, a patch of Amaranthus, badly infested by larvæ varying in size from those recently hatched to others nearly mature, was sprayed with some of this mixture. The spray was applied very thoroughly to the upper and lower surfaces of the leaves with the same apparatus as used in experiment No. 1. The following day the larvæ were unharmed. The leaves showed a good even coat of the arsenate. The sprayed plants were kept under daily observation until September 13, at which date they were destroyed. On the 9th and 10th of September it was noted that the larvæ were growing nicely and appeared to relish the poison-coated leaves.

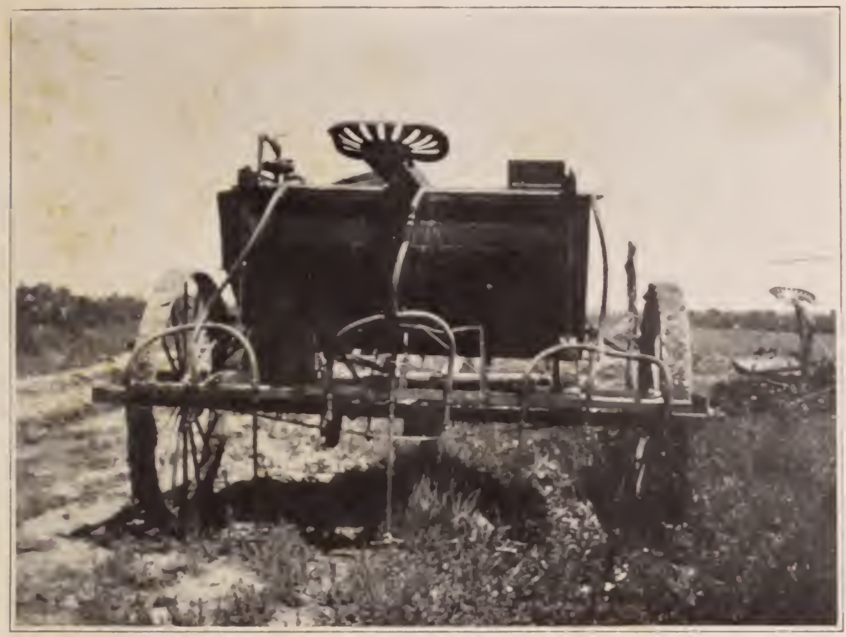

FIG. 1.—GEARED TRACTION SPRAYER SUITABLE FOR THE TREATMENT OF SUGAR BEETS AGAINST THE HAWAIIAN BEET WEBWORM. (ORIGINAL.)

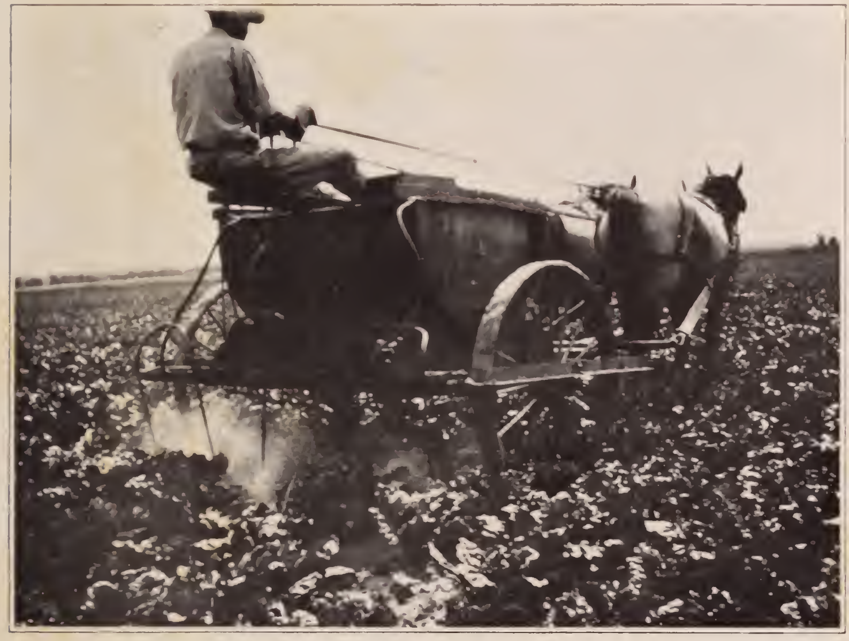

FIG. 2.—GEARED TRACTION SPRAYER IN OPERATION IN SUGAR-BEET FIELD AGAINST THE HAWAIIAN BEET WEBWORM. (ORIGINAL.)

September 12, all the larvæ which had not matured were still feeding and showed no ill effects from their diet of arsenate of lead and Amaranthus leaves. The spray mixture caused no injury to the foliage.

In this test a standard grade of arsenate of lead was used at the rate of 6¼ pounds in 100 gallons of water, and it is difficult to understand why it failed to kill the tender Hymenia larvæ. Of course, such a test as this can not be considered conclusive, but it would indicate that less effective results would be obtained with arsenate of lead than with Paris green.

Experiment No. 4.—Lime-sulphur solution, 1 gallon, in 15 gallons of water. November 1, a few infested beets were sprayed with a small quantity of this solution. A thorough application was made to the upper surface and underside of the leaves with an atomizer. Larvæ which were drenched with the solution appeared to die promptly. The weather was hot and clear at the time of the application. Two days later the larvæ had been reduced somewhat in numbers but there were still plenty of living specimens present. Some of the leaves were severely burned. November 5, the coat of lime was still very good. The larvæ were feeding on the coated leaves and were apparently unharmed. This solution apparently killed only the larvæ which were thoroughly drenched at the time of the application. The beet foliage was severely burned, and on the whole the results were not promising.

Experiment No. 5.—Lead chromate, 2 ounces, in 8 gallons of water. December 16, a few infested beets were sprayed with a small quantity of this mixture. The application was made to the upper and lower surfaces of the leaves with an atomizer. The mixture appeared as a yellow coating on the leaves and adhered very well. The weather was hot and clear. Three days later the larvæ were still alive, but had ceased feeding, and were clinging to the leaves in a listless manner. During the following two or three days they dropped to the ground and died. The sprayed foliage showed no burning. It is not possible to form a definite conclusion from this meager test, but it indicates that lead chromate at this strength is very slow in its killing effects.

In another similar test lead chromate was used on beets at the rate of 2 ounces in 4 gallons of water. Unfortunately an illness of the author prevented the making of observations as to the effect of this strength on the larvæ. Ten days after the application it was noted that two heavy rains had failed to wash the coat of poison from the leaves and that no burning had resulted. It is evident that this new insecticide has some good points, and it should be given a thorough trial.

The results of the experiments may be summarized as follows:

Experiments with insecticides.

Experiment No.	Date.	Insecticide used.	Effect on larvæ.	Injury to foliage.	Remarks.
1	1910 Sept. 1	Paris green, 4 pounds, and lime, 4 pounds, in 100 gallons of water.	Ineffective....	Slight...	The poor results were due to the poison being applied to the upper surface of beet leaves where the larvæ failed to reach it.
2	Sept. 7	Paris green, 2 pounds, and whale-oil soap, 8 pounds, in 100 gallons of water.	Absolutely effective.	None....	Spray applied properly to the under surface of beet leaves.
3	...do.....	Arsenate of lead, 1½ ounces, and molasses, 1 quart, in 1½ gallons of water.	Ineffective....	...do.....	Applied to the upper and lower surface of Amaranthus leaves. There is no apparent reason for its failure to kill the larvæ.
4	Nov. 1	Lime-sulphur solution, 1 gallon, in 15 gallons of water.	.....do.........	Severe..	Applied to beet leaves. A few larvæ were killed by contact with the solution.
5	Dec. 16	Lead chromate, 2 ounces, in 8 gallons of water.	Possibly effective.	None....	Applied to beet leaves. The poison was very slow in its killing effect.

It will be seen from the record of experiment No. 2 that this webworm can be effectively controlled on beets with Paris green. When this poison is applied at the rate of 2 pounds in 100 gallons of water it will not burn beet foliage and in this formula it is better to omit lime and use whale-oil soap. The soap serves as an effective adhesive agent and when it is used the poison is very evenly distributed over the leaf surface.

As "spinach" is used as food by human beings while the plants are still young and tender, it is obvious that it would be unsafe to spray this crop with an arsenical. Instead of an arsenical it is recommended that the following nicotine-soap combination be used on spinach:

Nicotine sulphate	1 fluid ounce.
Whale-oil soap	4 ounces.
Water	4 gallons.

This formula was successfully used by the author at Honolulu, against the common cabbage worm (*Pontia rapæ* Linn.), the larva of the diamond-back moth (*Plutella maculipennis* Curtis), a looper (*Autographa precationis* Guen.), and the beet army worm (*Caradrina exigua* Hbn.). It has also been used effectively against several species of aphides or plant-lice and thrips. Although this formula has not been actually tested on Hymenia larvæ, there is no reason to believe that it would not prove entirely effective.

For treating moderate-sized plats in gardens a portable compressed-air sprayer or a bucket pump will give good results. The sprayer should be fitted with a short extension rod, an elbow, and a nozzle of the Vermorel type, which will deliver a fine, mist-like spray. The elbow makes it possible to coat the underside of the leaves thoroughly. It is essential to bear in mind that, unless this surface of the foliage is thoroughly covered with the poison, the spraying will be ineffective. In the gardens about Honolulu, the difficulty of spraying the lower surface of the leaves is greatly increased by the closeness with which beets are planted in the mounded-up beds. If the method of planting were modified so that the plants were grown in slightly separated rows, it would simplify the matter of spraying.

It is evident that if sugar beets are to become a profitable crop in the Hawaiian Islands it will be necessary to spray them to prevent the ravages of this pest. For spraying large areas, such as fields of sugar beets, it is better to use a large geared or power sprayer. In some experiments which the author conducted on sugar beets in Colorado, against a somewhat similar species, the sugar-beet webworm (*Loxostege sticticalis* L.), ordinary barrel sprayers and geared sprayers, of 125 gallons capacity, were successfully used. With the nozzles arranged as in the accompanying illustration (Plate I, figs. 1, 2), it is an easy matter to spray thoroughly the underside of the leaves, if a pressure of 80 to 120 pounds is maintained.

DESCRIPTIONS OF THE EARLIER STAGES.

By H. G. Dyar, Ph. D.

The egg.—Uniformly elliptical, strongly flattened on the upper and lower sides, smooth, minutely granular; white (in alcohol). Size 0.6 by 0.4 by 0.25 mm.

Laid singly on the underside of the leaf near a vein.

Larva, stage 1.—Head rounded, not much higher than wide, slightly notched at vertex; smooth, shining testaceous whitish, with four large, black, pigmented ocelli close together in a semicircle, setæ rather coarse, pale, those next the ocelli darker. Width, about 0.25 mm. Body cylindrical, slender, uniform, whitish or colorless (in alcohol). Setæ coarse, from small concolorous tubercles, i and ii nearly in line with some coarse skin spinules near them; iv and v superposed, approximate; vi wanting; vii of three setæ at the leg base. Legs long, slender, normal.

The intermediate stages are not complete in the material. In all the larva is whitish throughout, marked only with a subdorsal black speck on joints 2 and 3.

Larva, last stage.—Head rounded, higher than wide, notched on vertex, clypeus high, reaching vertical notch; whitish, with brown freckles on the vertices of the lobes, cut by a central space devoid of these spots; five pigmented ocelli in a semicircle and one colorless one behind. Width, 1.2 mm. Body cylindrical, slender, uniform, the segments irregularly annulate; abdominal feet slender, cylindrical, the plantæ circularly expanded, the crochets in two-thirds of a circle, the open space on the outside; setæ fine, from concolorous invisible tubercles, i and ii in line, iv and v approximate, superposed, iii and vi normal, vii of three separated setæ; joint 2 with six setæ on the shield in two rows, the shield concolorous; two setæ each for the prespiracular and subventral tubercles; joint 3 with iia and iib in line, iii separate, iv and v approximate, vi free. Color whitish, a long brown patch at the edge of the shield on joint 2 and over tubercles iia and iib on joint 3. Spiracles elliptical, those of joint 12 larger than the others.

The cocoon.—The cocoon is composed of silk with fragments of extraneous substances attached to the outside. Elliptical in shape, simple.

The pupa.—Of the obtected type; pale brown, the eyes dark. Cremaster square and flat, with a row of long, slender, terminal pale spines with hooked tips. Surface smooth, without sculpture. Size 10 by 2.5 mm.

APPENDIX.

By F. H. Chittenden, Sc. D.

Owing to the fact that Mr. Marsh's report on the Hawaiian beet webworm (*Hymenia fascialis* Cram.) was completed at Rocky Ford, Colo., he had no facilities for looking up the literature on the species. Moreover, it was thought advisable, owing to the difficulty of describing the earlier stages in alcohol, that a technical description be made by a specialist, hence this latter work was kindly furnished by Dr. Dyar, while the writer has compiled the description and synonymy of the species and outlined its distribution, history, and bibliography. In the preparation of the bibliography, Mr. Thomas H. Jones assisted, while the photograph of the moth was prepared by Mr. C. H. Popenoe, and the drawing of the immature stages by Mr. J. F. Strauss.

Much has been written of this species in a technical way, but practically nothing has been published of importance, to the writer's knowledge, in regard to the biology of the insect, or description of its earlier stages. Hence the notes which Mr. Marsh has furnished are of great value, especially as he treats the insect in detail from the standpoint of its occurrence and injuries in Hawaii, and has also performed valuable experiments in the line of remedial measures. It should be added that this species, since it occurs throughout the Gulf region west to California, is apt to be troublesome at any time.

DESCRIPTION AND SYNONYMY.

Hymenia fascialis was first described in the year 1782 by Cramer. The following is the synonymy accorded by Dr. Dyar in his list of North American Lepidoptera, published in 1902.

fascialis Cramer, Pap. Exot., iv, 236, 1782, syn.
angustalis Fabricus, Mant. Ins., ii, 222, 1787.
recurvalis Fabricus, Ent. Syst., iii, 2,237, 1794.
diffascialis Hübner, Verz. bek. Schmett., 361, 1826.
albifascialis Boisduval, Faun. Ent. Mad., 119, 1834.

The species has also been placed in the genera Zinckenia and Spoladea.

The following is a somewhat free translation from Cramer's original description in French:

> Fig. O—*Fascialis.*—The white band and the spots on the black ground of this little moth, of which the two surfaces of the wings carry the same colors, are of a mother-of-pearl luster. The antennæ are filiform, the feet very long and slender, similar to all those which belong properly to the so-called family *Phal.* [*æna*] *Pyralis.* Monsieur M. Houttium has received it from Japan.

On the same page, as throughout the work, a similar description is furnished in Holland Dutch.

The reference to the illustration is Volume IV, of the same work, page 398, figure O.

The synonymy which follows is in accordance with Moore:

Phalæna recurvalis Fabricius, Syst. Ent., p. 407 (1775) ; Ent. Syst., iii, 2, p. 237 (1794).

Zinckenia recurvalis Zeller, Lep. Micro. Caffr. Kongl. Vet. Akad. Handl., p. 55 (1853) ; Lederer, Pyral. Wien. Ent. Mon., vii, p. 437 (1863) ; Snellen, Tijd. voor Ent., 1872, p. 95; Meyrick, Tr. Ent. Soc. Lond., 1884, p. 308.

Spoladea recurvalis Guenée, Delt. et Pyral., p. 225, pl. 8, fig. 5 (1854).

Hymenia recurvalis Walker, Cat. Lep. Het. B. M., xvii, p. 396 (1859).

Phalena fascialis Cramer, Pap. Exot., iv, pl. 398, fig. o (1782). Stoll, id., v, pl. 36, fig. 13 (1791).

Phalæna angustalis Fabricius, Mant. Ins., p. 309 (1787).

Hymenia diffoscialis Hübner, Verz. bek. Schmett., 361 (1825–7).

Hydrocampa albifascialis Boisduval, Faun. Ent. Madag. Lep., p. 119, pl. 16, fig. 1 (1834).

?Phalæna nigrella Linnaeus, Syst. Nat., Ed. 13, iii, App., p. 225.

DESCRIPTION OF THE GENUS.

The genus Hymenia is defined as follows:

> Forewing rather narrow, triangular; cell more than half the length; first subcostal at one-fifth before end of the cell, third bifid, fifth straight from end of cell; discocellular slightly concave, radials from the ends; middle median very close to end of cell, lower at nearly one-third; hindwing short, rather broad, apex convex, exterior margin convex in the middle; cell two-fifths the length; subcostals from end; discocellular obliquely concave, radial from lower end; two upper medians from end of cell, lower at one-third. Body moderately slender; labial palpi ascending, slightly curved, reaching level of the eyes, second joint laxly squamous, broadest at the base, third joint small, slender, pointed; maxillary palpi slender; antennæ setaceous, basal joint nodular; legs slender, smooth, spurs long, hind spurs equal. (Moore).

DESCRIPTION OF THE SPECIES.

The species is described as follows:

> Dark vinaceous-brown; in some lights olivescent greyish-brown; forewing with a short blackish-bordered white band from the costa before the apex, below and exterior to which are three small inwardly curved superposed spots.

which approach a dentate transverse white band extending from upper end of the cell to the posterior margin, this band being continued across the hindwing to near anal angle. Cilia with an interrupted brown inner line, alternated with white on forewing, entirely white on hindwing, bands on abdomen white, collar, front of head, base of palpi, and legs yellowish; tip of palpi and bands on fore-legs blackish.

Expanse seven-tenths to nine-tenths inch. (Moore.)

DISTRIBUTION.

In Dr. Dyar's list the distribution accorded this species includes the United States, South America, southern Europe, South Africa, and Australia. There is also a record of this species occuring in India.

Cramer's type was from Japan. Hampton states that its habitat comprises "Neotropical and Ethiopian regions"; Palæarctic Asia from Syria to Japan; the whole oriential and Australian regions.

In the United States National Museum this species is represented by specimens from Key West, Fla. (Evermann); Miami, Fla. (Barnes); Jamaica, Dallas County, Ala. (Trelease); and Port au Prince, Haiti. To make this list more complete we should add California and Hawaii, the islands of Madagascar, Bourbon (Reunion Id.), and Mauritius.

From the above it will be noted that this species is evidently of tropical origin, that it has been well disseminated nearly around the world, but that it is still confined to tropical, semitropical, and temperate climates. In the United States it probably has a larger range than above indicated. It at least ranges through the entire Gulf region to California.

HISTORY.

As has previously been stated, the species was first described by Pierre Cramer (1), who figured and described the moth, the description being in both French and Dutch, appearing in 1782. The type specimen was from Japan. In 1884–1887 Moore (2) furnished a technical description, with complete bibliography, which has been transcribed in previous pages. Following this, in 1900, Mr. Edward Barlow made mention of injuries by the larvæ to *Amaranthus mangostanus*, a pot herb in India, quoting Moore's synonymy and description. In 1907 Mr. W. W. Froggatt (6) stated that this little moth was common about Sydney, Australia, and that the larvæ were sometimes destructive to salt-brush hedges. Two years later (1909) Mr. O. H. Swezey (7) stated that the larva was fed on Euxolus, portulaca, garden beet, coxcomb, other amarantaceous plants, and on chenopodiaceous weeds. The same year Messrs. Lefroy and Howlett (8) published a short note on this species, stating that the larva attacked cultivated amaranthus, beet root, maize, and "other garden plants."

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